American Museum Novitates

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET, NEW YORK 24, N.Y.

NUMBER 1688 NOVEMBER 12, 1954

A Gigantic Crocodile from the Upper Cretaceous Beds of Texas

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INTRODUCTION

One of the principal discoveries of the 1940 paleontological expedition of the American Museum of Natural History to the Big Bend region of western Texas, particularly to localities immediately east and southeast of the Chisos Mountains, was the fragmentary remains of the skull and jaws, and associated bones, of a gigantic crocodile of Cretaceous age. This specimen was discovered by Barnum Brown in the upper part of the Aguja formation west of Glenn Spring, Big Bend National Park, and was excavated by Brown and Bird. At the Museum it was prepared by Bird. A plaster restoration of the skull and jaws was then made, in which almost all of the recovered bone fragments were incorporated, this restoration being based upon careful measurements of the materials at hand, as well as upon comparisons with other crocodilians, both fossil and recent. The purpose of the present paper is to describe the known fossils of this gigantic crocodile, and to compare it with other large crocodilians to which it may be related.

At this place a few remarks can be made about the Aguja formation, which consists of sandstones, shales, and clays that form a narrow belt outcropping around the Chisos Mountains except on the south side of the uplift. These sediments were originally described by J. A. Udden in 1907 as part of a general study of the geology of the Chisos region, and he designated them as the "Rattlesnake beds." In 1933 W. S. Adkins renamed these beds the Aguja formation, since the term "Rattlesnake" was preoccupied.

According to Adkins, the Aguja formation is composed of three types of sediments, namely, coarse-grained, fossiliferous sandstones, varicolored clays, and shelly clays. Parts of the Aguja sequence contain marine fossils, but some of the clays contain reptile bones that until the present time have been virtually undescribed. Adkins states that the reptiles are found "in the lustrous and dull carbonaceous beds above the basal Aguja sandstones. . . . Above the ammonite beds about 3 miles northwest of Vieja Pass dinosaur beds occur in a brownish silt" (Adkins, 1933, p. 508).

At the time he made his study of the Chisos area, Udden noted the presence of large bones in the Aguja formation. Some of these fossils were sent to S. W. Williston, who identified them as belonging to several types of dinosaurs, several turtles, and a crocodile "not previously known." Williston regarded this fauna, on the basis of the meager evidence then available, as of late Cretaceous age, and he correlated it very tentatively with the Belly River or perhaps the Judith River assemblages farther to the north, an opinion that is corroborated by later evidence. He made no further remarks about the crocodile "not previously known." Since the publication of Williston's notes in 1907, almost nothing except for passing references has been written about the vertebrate fauna of the Aguja formation. The present paper is intended as the first of several contributions that will describe and discuss the Aguja reptiles.

DESCRIPTION AND DISCUSSION

Diagnosis

PHOBOSUCHUS NOPCSA

Phobosuchus Nopcsa, 1924, Centralbl. Min., Geol., Paleont., 1924, p. 378.

Generic Type: *Deinosuchus hatcheri* Holland.

Phobosuchus riograndensis, new species

Type: A.M.N.H. No. 3073. Almost complete premaxillae and part of a right maxilla, portions of left articular, angular, and surangular, right and left dentaries and right and left splenials; one dorsal vertebra, probably the twelfth vertebra of the presacral series; right scapula, possible portion of a right ilium; scutes and other fragments.

Locality: East of Fresno Creek in the Big Bend National Park, Texas, on the south side of the Castellan trail, coming from Glenn Spring, and about one-fourth of a mile north of a large quarry, excavated by the Works Progress Administration.

Horizon: In yellowish, blue-gray clay, about 175 feet above the marine phase of the Aguja formation. Upper Cretaceous.

DIAGNOSIS: A eusuchian crocodile of tremendous size, the lower jaw being about 1800 mm. (approximately 6 feet) in length. The bones of the skull and jaw are heavy and the teeth are robust. In each premaxilla there is a large fenestra lateral to the external narial opening—a distinctive feature not seen in any other known crocodilian. The single known vertebra is strongly procoelus. The broad scapula indicates that the limbs may have been comparatively heavy. Scutes very heavy.

SIZE

Of course the most striking thing about *Phobosuchus riograndensis* is its extraordinary size and robustness. Here was a true giant among the crocodiles, far exceeding the largest modern crocodilians in size, and approached or equaled among fossil forms only by the gigantic *Dinosuchus* from the Tertiary beds of Brazil and by *Phobosuchus hatcheri* from the Cretaceous Judith River beds of Montana. As mentioned in the diagnosis, the lower jaw of this crocodilian is almost 2 meters in total length, as it has been restored. We feel that this length is not excessive but rather is on the conservative side, because, when the restoration was made, the proportions of some of the broad-skulled crocodilians, such as the subfossil *Crocodylus rhombifer* from Cuba, were followed, rather than those of the long-skulled types, such as *Crocodylus porosus* or *Crocodylus acutus*. Enough of the lower jaw was present to give an approximation of the total length, although unfortunately there were not contacts between all of the pieces. Nevertheless, it is probable that the restored length of the skull and jaws is not very much in error. The skull was restored as a very broad and heavy structure, comparable to but on a larger scale than that of *Crocodylus rhombifer*. It seems to us that the massiveness of the premaxillaries and of that section of the maxilla preserved justifies this restoration.

The single vertebra recovered is in scale with the skull and naturally dwarfs the vertebrae of modern crocodilians. *Phobosuchus riograndensis* must have been one of the dominant reptiles of the Aguja fauna, fully able to compete with the large dinosaurs that were its companions. Indeed, because, on the basis of comparative measurements, this great Cretaceous crocodile might have been 50 feet in length, it is logical to assume that it preyed upon other large reptiles—perhaps on small dinosaurs and on the young individuals of some of the giant dinosaurs.

SKULL AND LOWER JAW

The well-preserved premaxilliaries of *Phobosuchus* are, with the exception of the palatal edges, essentially complete. They are most noticeably different from the same bones in other crocodilians, in that they are

FIG. 1. *Phobosuchus riograndensis*, new species. Type, A.M.N.H. No. 3073, restored skull and lower jaw. Left lateral view, about × 1/12.

FIG. 2. *Phobosuchus riograndensis*, new species. Type, A.M.N.H. No. 3073, restored skull and lower jaws. Dorsal view, × 1/12.

very deep in proportion to their length and breadth. Because of this the external nostrils must have been elevated above the front of the skull to a relatively greater degree than is the case in other crocodiles. The dorsal posterior processes of the premaxillaries are relatively short, barely reaching back to the level of the space between the first and second maxillary teeth, for which reason they embrace only the anterior border of the external nares. In many crocodiles it is common for the dorsal portions of these bones to extend back as far as the third or fourth maxillary teeth, so that the external nares are completely enclosed by the premaxillae.

Five closely spaced alveoli are present in each premaxilla, as is typical in the eusuchian crocodilians. These alveoli increase markedly in size from the first to the third, the fourth is about equal to the second, while the fifth (as preserved in the left premaxilla) is less than one-half of the diameter of the first. A partly erupted tooth appears in this small fifth alveolus of the left premaxilla. It is obvious that while the third premaxillary tooth was the largest of the series (and it must have been a very large tooth) the second and the fourth teeth were not much smaller. Thus *Phobosuchus* had three very large premaxillary teeth, with a comparatively small anterior tooth next to the symphysis, and a very small posterior tooth. In several skulls of *Crocodylus* belonging to various species, the fourth premaxillary tooth is the largest of the series, while the fifth tooth, though small, is not so small in proportion to the other teeth as is the case in *Phobosuchus*. In some crocodile skulls, notably those of *Crocodylus acutus* and *Crocodylus rhombifer,* the first two premaxillary teeth are very small.

The borders of the premaxillary foramen are incompletely preserved, but enough bone is present to indicate that the foramen must have been moderately large and somewhat broader than long. In this respect *Phobosuchus* may be compared with the broad-skulled *Crocodylus rhombifer*. The foramen has a marked forward position, and almost all its aperture is anterior to the external nares, rather than being directly beneath the nares, as is common in the eusuchians.

The external nares, in turn, are placed at a little distance behind the anterior border of the snout, as is common in *Crocodylus*. To what extent the nasals united with the premaxillaries to form the posterior border of the nares is not clear from the sutures present. A small fragment of the right nasal, attached to the right maxilla, suggests from its position that the nasal bones were quite broad.

A description of the premaxillae of *Phobosuchus* would be incomplete without particular mention of the large fenestra in each bone, lateral to

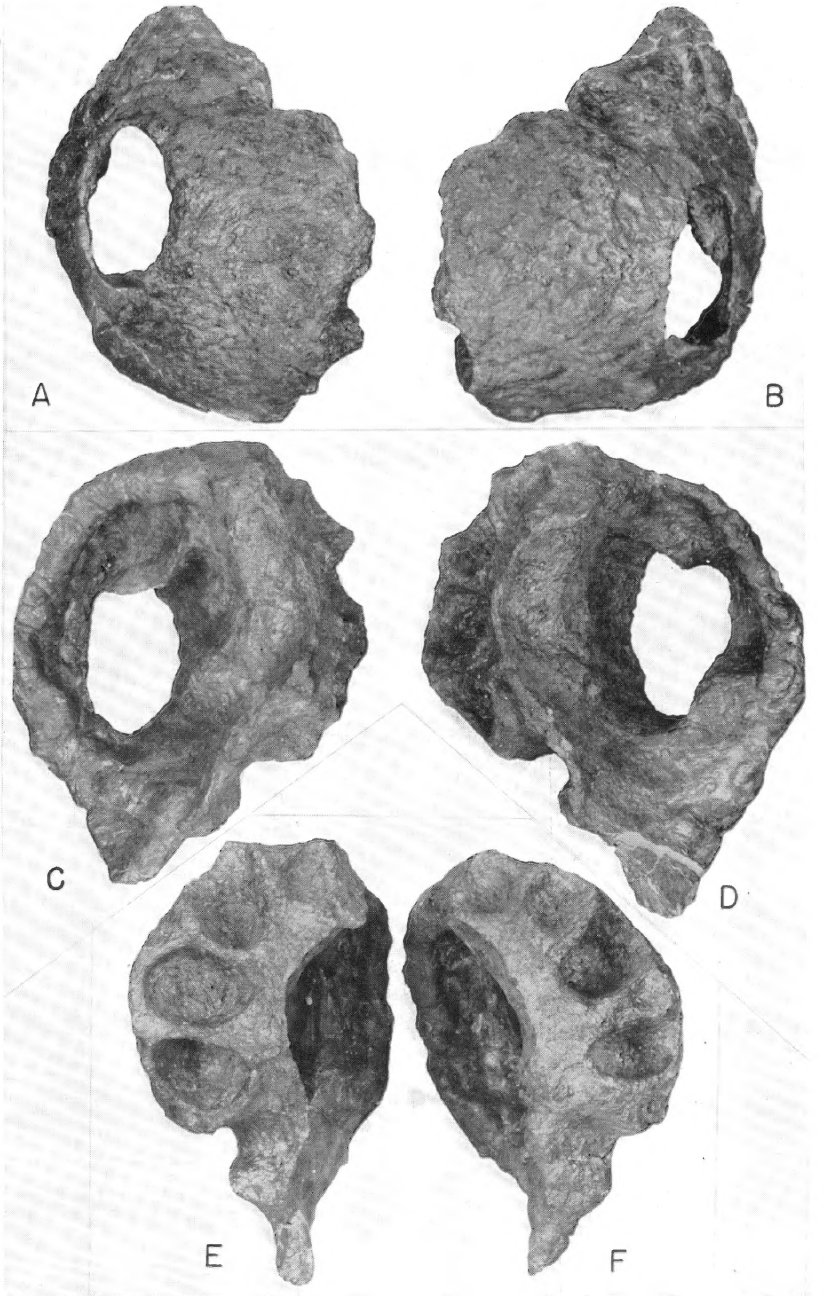

FIG. 3. *Phobosuchus riograndensis*, new species. Type, A.M.N.H. No. 3073. A. Left premaxilla, external lateral view. B. Right premaxilla, external lateral view. C. Left premaxilla, internal lateral view. D. Right premaxilla, internal lateral view. E. Right premaxilla, palatal view. F. Left premaxilla, palatal view. All × 1/6. A, B, C, and D show position and shape of large premaxillary fenestra.

and somewhat in front of the external nares. Each of these openings is roughly about twice as long as wide, is ovally elongated, and measures more than one-third of the total length of the element it occupies. No such fenestrae are to be found in any other known crocodilians. It is difficult to guess at their functional significance, but it seems reasonable to suppose that their development may have been correlated with giantism in this crocodile. Perhaps this is an example of fenestration to cut down weight, so frequently seen in the skulls of giant reptiles. It is not very probable that *Phobosuchus* had a double set of nostrils, nor were these openings for the accommodation of long lower teeth, as is the case in some crocodilians. Whatever may have been their purpose, they make *Phobosuchus* unique among the Crocodilia and therefore may be regarded as a very good generic character for this crocodile.

As mentioned above, a considerable portion of the outer surface of the right maxilla is present in this crocodile. This large bone mass lacks direct sutural contact with the premaxilla, but the break between the two bones is so close that any loss appears to have been negligible. At the juncture of the premaxilla and maxilla there is a very large, deep notch, as is usual in the Crocodylidae, for the reception of the fourth dentary tooth. The evidence of the maxilla, added to that of the premaxillae, leads us to believe that the skull was massive and relatively broad throughout.

Six alveoli and part of a seventh are present in the maxillary fragment. The third alveolus contains a huge, stout tooth, while in the fourth and sixth alveoli there are partly erupted teeth. All the alveoli are close together and increase in size up to the fourth, after which they gradually decrease as far back as they have been preserved. However, the third, fourth, and fifth alveoli are so near to one another in size that the three teeth occupying them in life must have been about equal. In the typical Crocodylidae the fifth maxillary tooth is the largest of the series, although frequently the fourth tooth is almost its equal in size. In the alligator the fourth tooth is the largest, while the third and the fifth approach it in dimensions. Of course we can only make a guess as to the total number of teeth on each side in *Phobosuchus*. It has been restored with 18 teeth, five in the premaxilla and 13 in the maxilla. *Crocodylus* commonly has 18 or 19 teeth on each side in the skull.

No sutures are preserved with the maxillary fragment, with the exception of a partly crushed union with a fragment of the right nasal, already mentioned. A small portion of the right palatal fenestra is indicated, and it shows that this opening extended forward to about the level of the sixth maxillary tooth, which is farther forward than in most

eusuchian crocodilians. In the long-snouted *Crocodylus acutus* the front border of the palatal fenestra is opposite the tenth maxillary tooth; in the salt-water crocodile (*Crocodylus porosus*) it is opposite the ninth maxillary tooth; in *Crocodylus rhombifer* it is opposite the eighth maxillary tooth; in *Crocodylus robustus* it is opposite the seventh maxillary tooth. This forward position of the palatal fenestra can be added to the evidence already cited for making the skull of *Phobosuchus* very broad and comparatively short. The fenestra seems to have been very narrow at its anterior margin.

The lower jaws are represented by a number of fragments, six of which are from the left ramus, three from the right, with one section of a splenial unplaced in the final restoration. Enough bone is present in the left ramus to determine its length with a reasonable amount of certainty, as mentioned above. The anterior ends of both rami are fairly well preserved, and these indicate that the symphysis extends back to the level of the fifth mandibular alveoli, the usual position for the posterior border of the symphysis in the Crocodylidae. In *Alligator* the symphysis is shorter, as might be expected from the shape of the jaw, and the same seems to be true for a giant crocodilian from beds of probably Pliocene age in Brazil, this latter form being the one named *Brachygnathosuchus* by Mook, but which may be, as Patterson has shown, the same as *Dinosuchus*. The splenials of *Phobosuchus* enter the symphysis by small, slender processes but form no essential part of it.

Six alveoli are indicated in the bone preserved of the right dentary, although that of the second mandibular tooth is somewhat obscure. The first and third teeth are present in a partly erupted condition, and the large fourth dentary tooth, fully developed but with another partly erupted tooth pushing in beside it, is also present and partly preserved. The fourth tooth is also present in the left dentary. The first and fourth dentary teeth are enlarged, as is the case in most of the eusuchians. Posterior to the fourth dentary teeth the succeeding alveoli are comparatively small and relatively close together. In the left dentary they are present as far back as the ninth tooth.

Sizable portions of the left articular, angular, and surangular are present, but these elements are not sufficiently complete to warrant individual description. It may be said that in their essential features they resemble closely the same bones in other genera of crocodiles. In the restoration of the left ramus, they, together with the sections of the dentary, furnish evidence to determine the character of the jaw with a good degree of accuracy. Part of the right angular is also present and is important in that it furnishes information as to a part of the left angular that is missing.

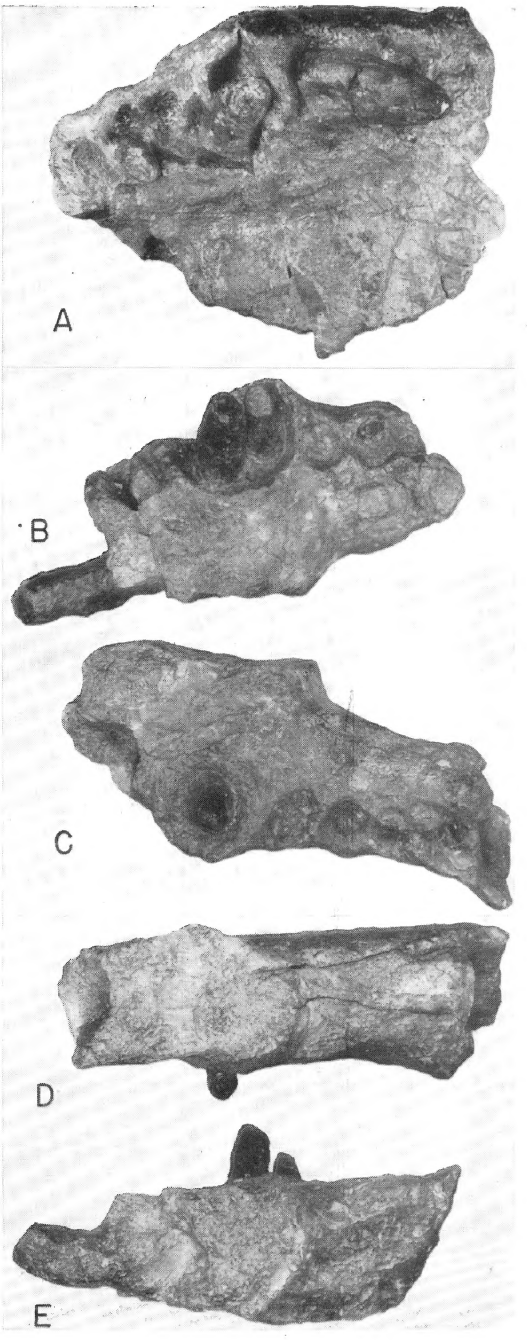

FIG. 4. *Phobosuchus riograndensis*, new species. Type, A.M.N.H. No. 3073. A. Anterior portion of right maxilla, palatal view. B. Symphyseal portion of right dentary, dorsal view. C. Symphyseal portion of left dentary, dorsal view. D. Symphyseal view of left dentary, inner view. E. Symphyseal view of right dentary, inner view. All × 1/6.

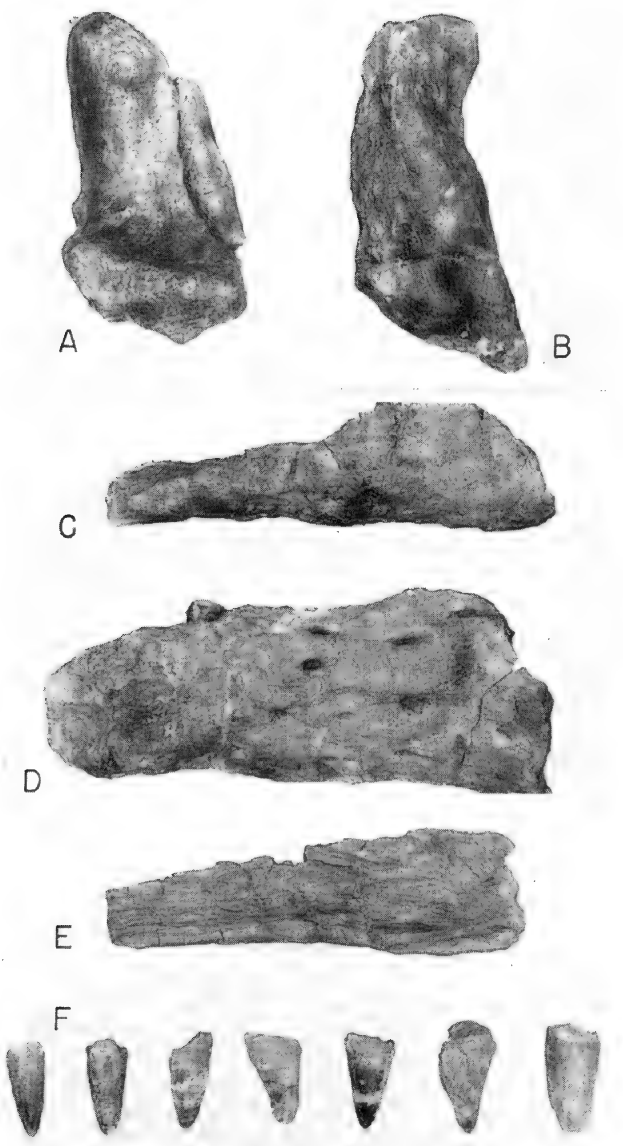

FIG. 5. *Phobosuchus riograndensis*, new species. Type, A.M.N.H. No. 3073. A. Left articular with posterior portion of left surangular in position, dorsal view. B. Fragment of left surangular, internal view. C. Anterior portion of left angular, external view. D. Part of left dentary, external view. E. Part of right (?) splenial, lateral view. F. Various teeth. All × 1/6.

The mandible as restored is proportionately stout as compared with its length. The retro-articular process is inflected somewhat inwardly and quite sharply up, a portion of this element and an attached fragment of the surangular deciding its course. The posterior Meckelian opening is very large and spacious, probably as an accommodation for the insertion of the very large adductor muscles that would be developed to close the huge, 6-foot jaws. Very little is preserved of the border of the external mandibular fenestra, but the internal fenestra is small.

The external surfaces of the angular and surangular are roughly sculptured, as are the other bones of the skull and jaws. The dentary shows numerous vascular openings, which diminish in size towards the anterior end of the jaw.

From the foregoing description and comparisons it is evident that the skull and lower jaw of *Phobosuchus* show many resemblances to the skull and jaw in various species of *Crocodylus*. The crocodilian most closely comparable to *Phobosuchus* in size, namely, *Dinosuchus* (*Brachygnathosuchus*), is quite obviously an alligatorid, so that any comparisons beyond those of size are not close.

The modern large crocodiles, *Crocodylus porosus* (the salt-water crocodile) and *Crocodylus acutus* (the American crocodile), are long-skulled types which resemble *Phobosuchus* as to general anatomical characters but not as to proportions. On the other hand, the subfossil *Crocodylus rhombifer* from Cuba shows a general similarity in the proportions of the skull and jaw to *Phobosuchus,* as this Cretaceous crocodilian has been restored.

That *Phobosuchus* is to be placed in the Crocodylidae is indicated by its over-all resemblances to *Crocodylus,* and specifically by the strong development of the notch on either side of the skull between the premaxilla and maxilla for reception of the fourth dentary tooth. The conclusion here adopted that *Phobosuchus* may be regarded as a genus distinct from *Crocodylus* is based, so far as the skull is concerned, on the development of the large lateral fenestrae in the premaxillae.

The question of the distinction of *Phobosuchus* from certain genera of fossil crocodiles is considered below in the discussion of the vertebrae. Comparative measurements of the skull and lower jaw and indices are set forth in table 1.

Axial Skeleton

Although the axial skeleton is represented in this specimen by a single vertebra, this bone is sufficiently important as to warrant careful consideration. Moreover, all discussion concerning the relationship of *Phobo-*

TABLE 1

MEASUREMENTS (IN MILLIMETERS) AND INDICES OF THE SKULL AND LOWER JAWS IN CERTAIN CROCODILES

	Phobosuchus riograndensis A.M.N.H. No. 3073	*Crocodylus rhombifer* A.M.N.H. No. 6178	*Crocodylus porosus* A.M.N.H. (A.R.)[a] No. 24958	*Crocodylus acutus* A.M.N.H. (A.R.) No. 7139
Skull				
1. Length, premaxilla–supra-occipital	1500	575	563	705
2. Length, premaxilla–basi-occipital	1533	595	585	735
3. Length, premaxilla–quadrate	1670	660	622	790
4. Length of premaxilla	340	218	160	195
5. Width of premaxilla	190	95	58	65
6. Depth of premaxilla	260	72	50	50
7. Width across premaxilla	395	184	119	138
8. Width across maxillae at 5th tooth	535	257	178	186
9. Width across quadrates	987	400	300	352
Index 7/3 × 100	*24*	*28*	*19*	*18*
Index 7/8 × 100	*74*	*72*	*67*	*74*
Index 4/3 × 100	*20*	*33*	*26*	*25*
Lower Jaw[b]				
1. Total length of ramus	1805	500e[c]	735	895
2. Articular length of ramus	1650	440e	640	790
3. Depth at symphysis	102	44	41	41
4. Depth at mandibular foramen	260	90	107	108
5. Breadth of ramus at 6th tooth	125	45	40	42
Index 4/2 × 100	*16*	*20*	*17*	*14*
Index 5/2 × 100	*8*	*10*	*6*	*4*

[a] Department of Amphibians and Reptiles.

[b] Measurements of *Crocodylus rhombifer* from A.M.N.H. No. 6188.

[c] Estimated.

suchus to other giant Cretaceous crocodilians must, because of the nature of the type materials, be based on a comparison of vertebrae.

The vertebra of *Phobosuchus riograndensis* has been identified as probably the first dorsal vertebra in which both rib articulations are located on the transverse process, which would make it about the twelfth or thirteenth of the presacral series. There is no indication of a rib articula-

tion on the centrum, which would place the vertebra behind the cervical series, yet the centrum has a keel, which would place it far forward in the dorsal series. Moreover, there is a prominent facet for the head of the rib on the ventral surface of the transverse process, as is typical of the twelfth or thirteenth presacral (the first vertebra in which the transverse process bears both articulations) in other crocodiles. Unfortunately the end of the single transverse process preserved is so eroded that the facet for the rib tubercle is not to be seen.

The vertebra is strongly procoelous, so of course the posterior central articulation is strongly rounded. In this vertebra the diameter of the anterior articulation is considerably greater than that of the posterior one, as if the vertebrae were decreasing somewhat in size from cervical to dorsal region. Because of the huge head in this crocodile, one might expect the cervical vertebrae to be unusually heavy.

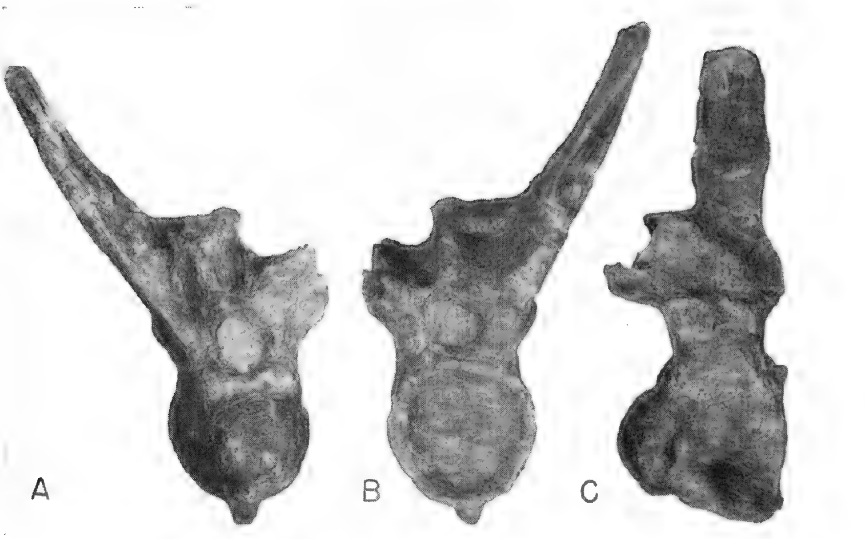

FIG. 6. *Phobosuchus riograndensis*, new species. Type, A.M.N.H. No. 3073, probable twelfth presacral vertebra. A. Posterior view. B. Anterior view. C. Right lateral view. All × 1/6.

One of the striking features of the vertebra is the strong, upward slant of the single preserved transverse process, that on the left side, probably the result of crushing. It is certainly at first misleading. For instance, when the vertebra was being studied the question arose as to whether it might be a dinosaur vertebra that had become associated with the crocodilian remains during fossilization. In some dinosaurs, especially the

trachodonts, the armored dinosaurs, and the ceratopsians, the vertebrae have the transverse processes directed up at a high angle. However, inspection of various dinosaurs ruled out this possibility, for even though the transverse process of the bone in question is directed up at a high angle, it is not like the same process in various dinosaur vertebrae. It and the centrum are decidedly crocodilian in all their aspects.

In most crocodilians the transverse processes of the anterior dorsal region are directed up at a slight angle, while those farther back in the series are almost horizontal in direction. It seems reasonable to think that the transverse processes of *Phobosuchus riograndensis* were probably inclined up at a fairly low angle, for the broken base of the transverse process on the right side of the vertebra here being described indicates that this process probably extended out in about the normal way. In fact, there is good reason to think that the difference between the angle of inclination of the transverse processes of the vertebra of *Phobosuchus riograndensis* and that of *Phobosuchus hatcheri* is comparable to that between an anterior and a posterior dorsal vertebra of a modern *Crocodylus.*

This brings us to the problem of generic differences between *Dinosuchus* and *Phobosuchus,* as based on the characters of the vertebrae.

Dinosuchus was first described by Gervais, the type being *Dinosuchus terror,* a single vertebra from the Amazon of Brazil. This vertebra is of gigantic size and strongly procoelous. In the original description the vertebra was regarded as possibly of late Cretaceous or Tertiary age, but the author emphasized that there was no definite field evidence as to its geologic position. Subsequentlv, in 1921, Mook described the genus *Brachygnathosuchus,* the type being *Brachygnathosuchus braziliensis,* based on the front portion of a mandibular ramus and some vertebrae. This is a gigantic crocodilian, the vertebrae of which resemble closely the type vertebra of *Dinosuchus terror.* Moreover, the lower jaw of this later discovery is definitely alligatorid. Nopcsa in 1924 decided that *Brachygnathosuchus* was a synonym of *Dinosuchus,* a judgment with which Patterson concurred in 1936. This certainly seems reasonable upon the basis of the evidence. Patterson has shown that characteristic upper Tertiary mammals, probably of Pliocene age, were associated with the crocodilian described by Mook.

On the assumption that *Dinosuchus* is an upper Cenozoic alligatorid, it can be eliminated from further consideration in this connection.

In 1909 Holland described a gigantic crocodile from the Judith River Cretaceous sediments of Montana, to which he gave the name *Deinosuchus hatcheri,* basing his description on some vertebrae, ribs, a pubis, some scutes, and various bone fragments. In 1924 Nopcsa called attention

to the description of *Dinosuchus* by Gervais, and proposed the generic name *Phobosuchus* for the giant crocodile from the Cretaceous of Montana.

It is unfortunate that at the present time no skull materials are known

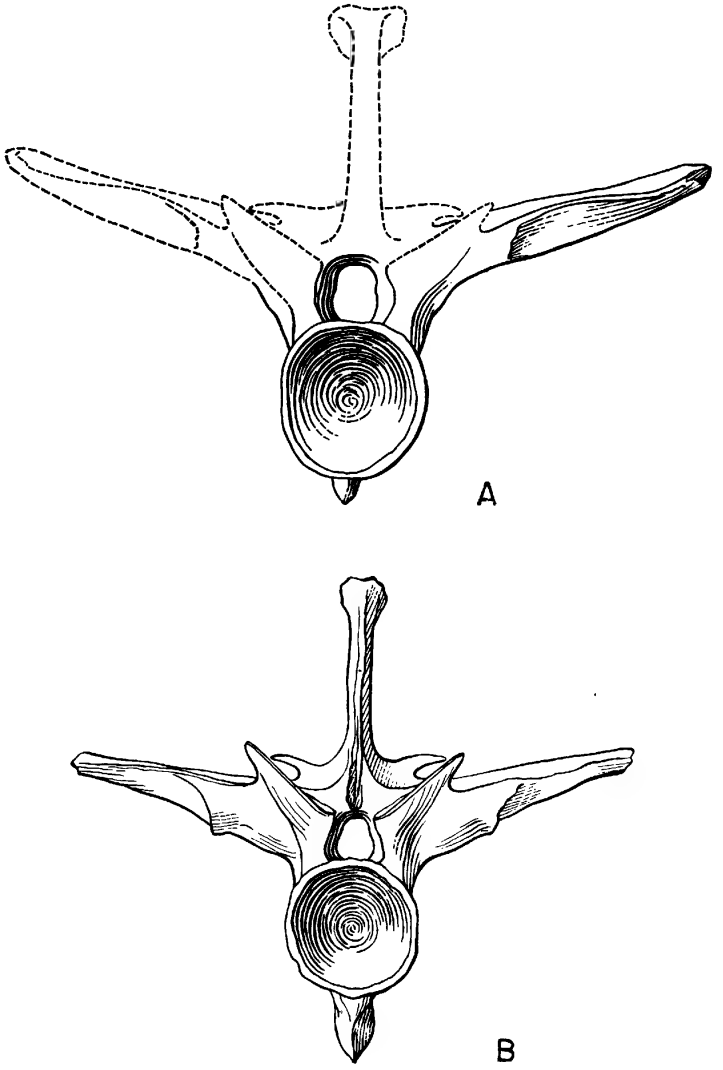

FIG. 7. Comparison of crocodilian presacral vertebrae. A. Probable twelfth presacral vertebra of *Phobosuchus riograndensis*, A.M.N.H. No. 3073, anterior view, × 1/6. Transverse process restored to what is considered its proper angle. B. Twelfth presacral vertebra of *Crocodylus acutus*, A.M.N.H. (A.R.) No. 7139, anterior view, × 1/3.

from the type species of *Phobosuchus*. This limits comparisons between the Texas and Montana forms to vertebrae, and here difficulties are introduced because the known vertebrae of the two species come from different parts of the vertebral series. Moreover, the comparison is not made any easier because of the apparent upward crushing of the transverse process in *Phobosuchus riograndensis,* discussed above. However, if allowances are made for the different positions of the two vertebrae in the column and for the distortion of the Texas specimen, the comparisons between the two bones are generally rather close. Certainly they are

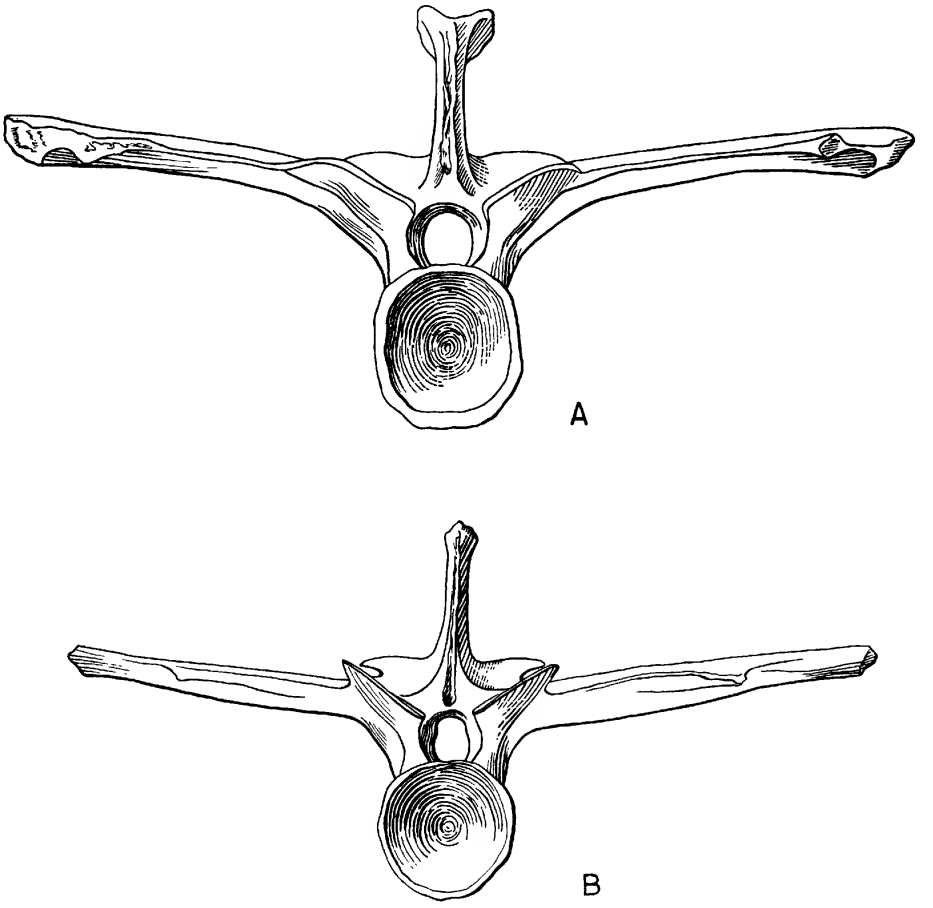

FIG. 8. Comparison of crocodilian presacral vertebrae. A. Probable sixteenth presacral vertebra of *Phobosuchus hatcheri*, Carnegie Museum No. 963, anterior view, × 1/6. (Redrawn from Holland.) B. Sixteenth presacral vertebra of *Crocodylus acutus*, A.M.N.H. (A.R.) No. 7139, anterior view, × 1/3.

closely comparable in size. Moreover, both vertebrae show similarities in the general shape of the articular surfaces of the centra and in the rather high neural arches. These are the basic comparisons on which the generic identity between the Judith River and the Aguja crocodiles is established.

Comparative measurements and indices are presented in table 2.

TABLE 2

MEASUREMENTS (IN MILLIMETERS) AND INDICES OF PRESACRAL VERTEBRA NUMBER 12[a] IN CERTAIN CROCODILES

	Phobosuchus riograndensis A.M.N.H. No. 3073	*Phobosuchus hatcheri* Carnegie Mus. No. 963	*Crocodylus acutus* A.M.N.H. (A.R.) No. 7139
1. Length of centrum	128	140	68
2. Transverse diameter, anterior articulation	112	122	50
3. Vertical diameter, anterior articulation	113	122	51
4. Transverse diameter, posterior articulation	76	95	43
5. Vertical diameter, posterior articulation	84	110	51
6. Vertical diameter of neural canal	51	52	20
7. Length of transverse process	174	270	78
Index 2/1 × 100	*88*	*87*	*74*
Index 6/3 × 100	*45*	*43*	*39*
Index 2/7 × 100	*64*	*45*	*64*

[a] Possibly presacral 16 in the Carnegie Museum specimen.

APPENDICULAR SKELETON

A fairly complete right scapula is among the several known skeletal bones of *Phobosuchus*. In general this scapula resembles the same bone in a modern crocodile, but it is comparatively heavier, as might be expected, and it appears to be inordinately short, considering the great size of the extinct crocodile. The upper edge of the scapula was carefully examined, to see if perhaps it was broken or eroded all the way across, thus allowing some restoration on the top of the bone that not only would increase its length but also make its proportions more nearly like those of the same bone in *Crocodylus*. However, there seem to be indications that part of this edge is the true edge of the bone, and, if such be the case, then

we must suppose that the scapula in *Phobosuchus* was very short and heavy. Perhaps there was a considerable cartilaginous suprascapular portion in life. Perhaps the limbs in *Phobosuchus* were short and stout as contrasted with those in smaller crocodilians, a condition that may very well have developed as the result of factors of relative growth. This, however, must remain as a supposition at the present time. The resemblances and differences between the fossil scapula and that of a recent crocodilian are set forth in table 3.

TABLE 3

MEASUREMENTS (IN MILLIMETERS) AND INDICES OF THE SCAPULA IN CERTAIN CROCODILES

	Phobosuchus riograndensis A.M.N.H. No. 3073	*Crocodylus acutus* A.M.N.H. (A.R.) No. 7139
1. Length	290	187
2. Width at narrowest point	78	26
3. Width at top	136	81
Index 2/1 × 100	*27*	*14*

One large piece of bone appears to be a part of the right ilium, but this identification is not positive. If part of the right ilium, then it is the posterior section of the bone. (See fig. 9.)

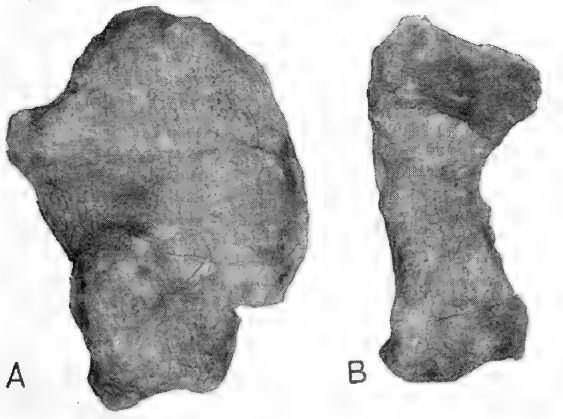

FIG. 9. *Phobosuchus riograndensis*, new species. Type, A.M.N.H. No. 3073. A. Part of a right (?) ilium, lateral view. B. Right scapula, lateral view. Both × 1/6.

There are various fragments that seem to represent portions of the appendicular skeleton, but they are all broken and are so indefinite in shape that even tentative identifications have, after considerable trial and error, been abandoned.

Scutes

A few scutes are among the fossils representative of *Phobosuchus riograndensis*. These are very heavy and thick, as might be expected in a

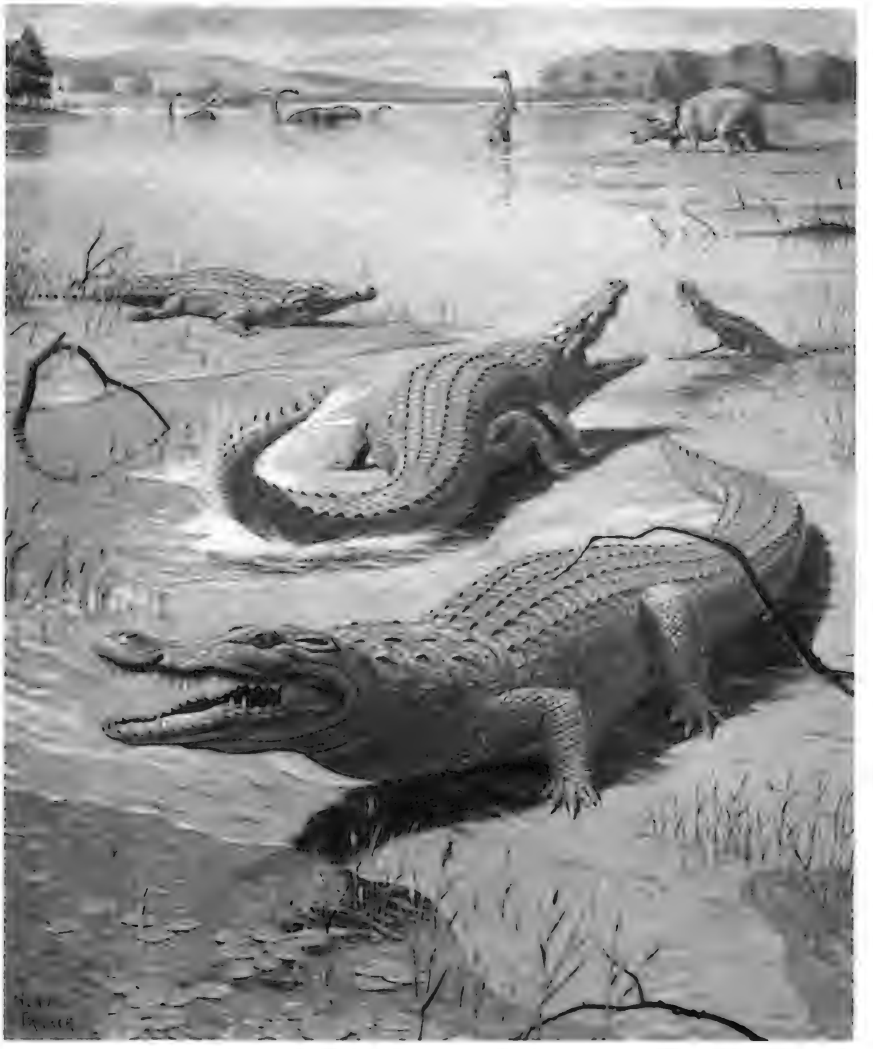

Fig. 10. Restoration of *Phobosuchus riograndensis* by Neave Parker. From the Illustrated London News, December 22, 1951; reproduced with the permission of the editor of the Illustrated London News.

reptile of this size. Holland, in his description of *Phobosuchus hatcheri,* emphasized the extraordinary thickness and the general swollen appearance of the scutes in that species. Indeed, the scutes of this new crocodilian from Texas are quite similar to those of *Phobosuchus hatcheri.*

CONCLUSIONS

From the above description and discussion it is apparent that an important member of the upper Cretaceous fauna of Texas was a gigantic crocodile, here designated as *Phobosuchus riograndensis.* The remainder of the fauna, as will be shown subsequently, contained huge sauropod dinosaurs, trachodonts, armored dinosaurs, and ceratopsians. It seems very probable that *Phobosuchus* was one of the great predators of Cretaceous times, and this crocodile may very well have hunted and devoured some of the dinosaurs with which it was contemporaneous.

Although definite age determinations cannot as yet be made, it appears probable that the Aguja fauna, as the above-mentioned assemblage may be called, is of general Belly River and Judith River affinities. This would place it in the upper portion of the Cretaceous sequence.

In the Judith River beds of Montana there is a giant crocodile, *Phobosuchus hatcheri,* which on the basis of present evidence would seem to be closely related to the giant crocodile from Texas described in this paper. This resemblance indicates a probably close relationship of the upper Cretaceous faunas of northern United States to those of the southern region.

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